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THE TECHNOLOGY OF COMMUNICATION SATELLITES IS SUFFICIENTLY ADVANCED THAT CONCERNED AGENCIES, SUCH AS UNESCO, SHOULD BEGIN TO PLAN FOR THEIR USE IN EXCHANGE OF DATA, NEWS TRANSMISSION, CULTURAL EXCHANGE, AND EDUCATION. GROUNDWORK IN TECHNOLOGY, IN THE DESIGN OF A SATELLITE COMMUNICATION SYSTEM, IN VALUE JUDGMENTS, IN AGREEMENTS OF COOPERATION AND CONDUCT, AND IN THE DISSEMINATION OF INFORMATION RELEVANT TO THE DECISIONS TO BE MADE SHOULD PRECEDE AND EXPEDITE THE USE AND DEVELOPMENT OF SPACE LINKS. THIS DOCUMENT IS AVAILABLE AS B.2402 FROM NATIONAL DISTRIBUTORS OF UNESCO PUBLICATIONS OR FROM THE DIVISION OF FREE FLOW OF INFORMATION, UNESCO, PLACE DE FONTENOY, PARIS-7E, FRANCE, FOR $1.00. (MF)

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No. 53

Communication satellites for education, science and culture

Reports and Papers on Mass Communication

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Communication satellites for education, science and culture

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PREFACE

The entirely new dimensions offered by telecommunication satellites represent a turning point in the history of human communication. Education by means of television can be vastly expanded. Natural barriers to cultural exchange between peoples can be overcome. Technical obstacles to the free flow of information can to a large extent be removed.

Many complex problems must, however, be solved before space communication can be fully applied for the benefit of all countries. The General Conference of Unesco has accordingly established a programme of studies and research on the uses of space communication for the free flow of information, the spread of education and greater cultural exchange.

The present paper forms part of that programme. Its author, Dr. Wilbur Schramm, is Director of the Institute of Communication Research at Stanford University, California (U.S.A.). He has written widely on mass communication including, most recently, the implications of space communication.

Dr. Schramm here examines the present pattern of satellite communication as well as problems and prospects for the future. He writes as an independent expert and, as such, assumes responsibility for opinions expressed. Dr. Schramm's study will, it is hoped, contribute to a better understanding of space communication and, in so doing, promote its more rapid application for the benefit of people everywhere.

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INTRODUCTION

The argument of this paper is that the technology of communication satellites has far outrun plans for their use; that unless these two strands of development are brought more closely into phase, the world stands to lose a considerable opportunity to share education, science, culture and international understanding; and that in the difficult task of matching the uses of these instruments to their potential, the United Nations agencies and organizations can and must play a significant part.

In the following pages we shall not be directly concerned with the problems of using the satellites for commerce, telephone service, or other purposes for which support is readily available and for which most satellite systems will be designed anyway. Rather, we shall focus on the problems [redacted]ging them into use to serve objectives like education, scien. and culture where the economic utility is not always so apparent and where special efforts will be required to realize the potential of the new technology. We shall try to suggest what direction those efforts might take.

First, let us establish a probable time-table for the new satellites.

Communication satellites are presently in the first stage of what is expected to be three stages of development. This is the period of point-to-point communication, wherein a satellite of relatively low power transmits a signal from a powerful ground transmitter to an extremely sensitive ground receiver. Ground stations of this type, used both for transmitting and receiving, cost in the millions of dollars, and therefore their use will be limited to connecting existing ground communication systems. For example, the North American telephone system is presently connected by the Intelsat satellites to the European telephone system; and a television programme prepared in Moscow may be carried by the Molniya satellites and rebroadcast in Vladivostok. It happens that the Intelsat satellites are synchronous and appear to remain always at the same point above the earth, whereas the Molniya satellites are placed in non-synchronous orbits with high pointing accuracy and narrow antenna beam designed to simplify the ground station as much as possible. But in both systems, ground communication systems are connected through a low-power satellite and sophisticated and costly terminals, so that telephone, television, teletype, facsimile, and other forms of message may be carried very long distances without microwave, cables, or high frequency radio.

The second stage of communication satellites will use satellites of higher power which will be able to serve less sophisticated receiving stations, costing perhaps one hundred thousand dollars or less. These so-called distribution satellites will thus be able to feed television to local broadcasting stations or other centres, and offer an alternative to microwave or long lines. In the stage of distribution satellites it is foreseen that access to the satellites will be much easier, and they may be used under different conditions to serve local reception points, network outlets, perhaps community antenna systems, and even some school systems.

The third stage is expected to be direct broadcasting, when much more powerful satellites (working at the level of several kilowatts, rather than a few watts for the first point-to-point satellites, or something of the order of 50 watts for distribution satellites) will be able to broadcast television or facsimile directly to home receivers. It is anticipated that such receivers may cost as little as 50 dollars more than the usual home reception devices for television, and thus it would be entirely feasible - if the other economic and political problems of such a system can be solved - to conceive of broadcasts from a single outlet that would reach millions of homes over a million square miles or more of the earth's surface.

The technological aspect of this development is going forward with great speed. In April of 1965, the first Early Bird satellite was placed 22,300 miles above the Atlantic Ocean, just off the coast of Brazil. It had a capacity of 240 telephone channels, and an estimated effective life of one-and-one-half years. When Early Bird was used for television, therefore, all its capacity was needed for that purpose and telephone messages had to be rerouted. The two Intelsat satellites placed in stationary orbit over the Atlantic and the Pacific, in 1967, have about twice the power of the pioneer Early Bird, and an expected life of about three years. These satellites are easily able to connect ships in the Atlantic, Pacific, and Indian Oceans, and ground stations in Australia and the South Atlantic, with the control centre of the Apollo space programme, in the United States; and they have carried television of the May Day parade celebration in Moscow, the landing of the first scheduled Japanese flight across the Soviet Union, and the funeral of Chancellor Adenauer, westward from Europe across the Americas as far as Tokyo and Sydney. A third family of Intelsat satellites is now in the prototype stage. These are to have a capacity of 1,200 telephone channels (or some desired combination of telephone and television) and an expected life of five years. And on the drawing boards is still another generation of Intelsat

satellites which is expected to have five or six times the capacity of the Intelsat-III series, and to be available in 1969 or 1970. Thus, in five years, the development of synchronous point-to-point satellites will have increased their capacity about 25 times and their expected lifetimes by a factor of 3 or 4.

Perhaps even more significant is the fact that satellites are now in orbit that have approximately the power that would be required for use as a distribution satellite, although they are not being employed precisely that way. A satellite is being built which is expected to operate at or near the power range that would be required of a direct broadcast satellite, though no such use of it is intended. The President of the Communications Satellite Corporation has said that from a purely technical point of view he feels a direct broadcasting satellite could be available within five years.(1) This is not to suggest that it will be available. Some very severe economic problems stand in its way. It would be expensive to develop, build, and launch; the necessary launch vehicle alone might cost over 100 million dollars. It would require dislocation of existing broadcasting arrangements in countries where communication systems are advanced, or the provision of extensive reception facilities in countries where the electronic media are not well developed. Still more difficult might be the political problems of programme control and overlapping coverage. Therefore, it is likely to be a great deal more than five years before we have direct broadcasting from satellites, and conceivable that we might never have it, although the advantage of long-range delivery of a large number of television and facsimile services ought at some future time to outweigh the disadvantages. It may be that we shall have available, long before the kind of direct broadcast satellite we have been talking about, special purpose satellites designed to meet the needs of certain countries, and operating in a range of power and band width which would let them offer a certain amount of direct service along with a basic service to rebroadcast stations.(2)

Looking ahead at this moment, through all the fog of technical, economic, and political uncertainties, we can hazard this forecast of a satellite timetable:

	Could technically be available	Likely to be in use
Point-to-point	Now	Now
Distribution	Now	In 3 to 5 years
Direct broadcast	In 5 years	In 10 to 15 years

Thus, the technical designers and builders of communication satellites have been sensationally successful and skilful in putting communication relays into space, and developing the knowledge and skill required to orbit still more remarkable machines. But they have left the harder tasks to the designers and planners who are not engineers. This latter kind of design and planning has lagged far behind the technical achievement. What we most need now, therefore, is not more and better satellites so much as better plans for using them.

In planning toward future use we must assume that a variety of electronic communication channels will be available to us in the late years of this century. For example, cables should be notably more efficient than now. The first high-quality oceanic cable was laid only the year before Sputnik, and had a capacity of 30 two-way telephone circuits. A transistorized cable is now being constructed to carry 720 telephone circuits, and there are some plans to design a cable for as many as 2,000 circuits. Experimental work is going on with "millimeter pipes" or wave guides, which will carry a very large number of electronic messages within a tiny tube. Experiments are under way also with laser beams, that seem able to carry an even greater number of messages. In the late 1900's, therefore, we may have high frequency microwave circuits able to carry a few circuits, cables able to carry a few hundred or a few thousand, millimeter pipes carrying perhaps 100,000, and laser beams carrying perhaps millions of message circuits. In this galaxy of telecommunications, satellites will probably be intermediate in capacity, carrying tens of thousands of circuits over a very long range, and able to interconnect simultaneously a very large number of stations over a large area without having to build a direct network of interconnexions with all those points. Satellites will, therefore, in all probability be very important in future communication systems, but they will not be alone, and the entire future of educational, scientific, and cultural communication will not rest with them.

Let us therefore suggest an approach which our planning for use of satellites might take. The basic question is not, how can we use the satellites but rather, how can the satellites help us with the kind of information exchange we consider important? If we put the emphasis on our needs for information - in the terms of this paper, on education, science, and cultural exchange - then we free ourselves from bondage to any particular technology,

(1) Address by Joseph V. Charyk, President of the Communications Satellite Corporation, to the Asilomar Seminar on Television, 22 May 1967. To be published.

(2) This, for example, is the kind of satellite proposed for the exclusive use of a developing country such as India, Indonesia, or Brazil, in the design exercise entitled Advanced System for Communications and Education in National Development (Stanford, 1967, in press). The proposed satellites would furnish a beam restricted as nearly as possible to the boundary of the country being served, and would operate at about 2,500 watts.

and can consider the usefulness of all information technologies, individually and in combinations. This has the further advantage of putting the emphasis where the greatest amount of planning will have to be focused, for we shall see in the latter pages of this paper that most of our planning for the educational, scientific and cultural use of satellites will be concerned with preparing what goes into the satellites, handling what comes out of them, and making the institutional and technical arrangements that will support them on the ground. And if we do indeed adopt this approach, then we shall surely find satellites very promising and potent elements in our communication system, but we shall be in a better position to say when a satellite will be more feasible than another form of exchange, and when our needs and capabilities will have developed to a point where use of a satellite is justified.

Looking back to the time-table, it is obvious that, as a practical matter, we should now be considering how distribution satellites can help us. Those will be with us, almost literally, tomorrow. But even while we focus on that development it is necessary to catch up some of the thinking we have neglected to do about the point-to-point satellite, and important not to foreclose the direct broadcast satellite in our plans, or the interim and special combination of distribution and limited direct broadcast instrument previously mentioned. These, too, may arrive faster than we anticipate.

Presently most of the planning activity in space communication, other than the design of more potent satellites, is aimed at organizing a viable system. These problems are technical, economic and political, as well as social and cultural, and the decisions that are being made may ultimately be of deep concern to all who hope to use satellites.

The kind of problem we are talking about is the size and shape of the system, the institutional framework to be organized around the satellites, the division of communication tasks among different sub-systems and channels, the relation of space to ground systems, the relation of regional and national satellites to the world system.

A primary question is whether there will be one system or more. The decision of the East European countries to go ahead with their own system would seem to answer that, and yet there are certain advantages to world-wide systems; and so the question remains whether the East European system and Intelsat* (the presently existing system using United States satellites) will both be world wide and parallel, or serve different parts of the world and connect or serve different parts and not be connected. Fifty-six nations have so far joined Intelsat*, and many or all of them may ultimately install their own ground stations in order to participate directly in the system.* Among the nations that have not joined, however, are the Soviet Union, the countries of Eastern Europe, China (mainland), and most of the countries of sub-Sahara Africa.

A secondary question is whether the system should be multi-purpose or special purpose - that is, whether there should be satellites for television and other specific purposes, or whether satellites should simply provide message capacity, usable for any kind of message. Intelsat, and its operating partner, Comsat, have argued that a multi-purpose system could be operated more efficiently and cheaply; some others, that a special purpose system would ensure that special purposes would be better served.

Both these types of questions were raised in connexion with the Ford proposal for television satellites in the United States. Ford proposed that satellites be developed and operated solely to serve the commercial and educational television stations of the country; some opponents argued that the job could be done more efficiently if the satellites were for general use. Ford proposed that the television satellites be operated by a public corporation, with the savings going to support educational television programming; Comsat argued that it could be better done if they were part of the Comsat-Intelsat system. These same questions have come up and will undoubtedly continue to come up in connexion with the international system also. On the one hand, there is an advantage in a single communication utility, with no need of switching between systems; on the other, there is a fear of excessive dominance by one nation or a few nations. On the one hand, there is the advantage of being able to use a satellite to full capacity by carrying whatever kind of message is available at a given time; on the other, there is the advantage of always having a channel available for a special purpose when it is needed.

As the long-range outlines of the satellite communication system take shape, another question will begin to intrude: how shall national or regional satellite systems be integrated with the world system? Many of the industrialized countries will probably want to operate their own satellites, as, for example, the television networks of the United States wish to feed their station outlets by satellite rather than microwave. Some of the developing countries, also, may find special need for a satellite to provide telecommunications for themselves. Thus, for example, it has many times been suggested that a country like Indonesia, whose people are scattered over 3,000 islands in a vast stretch

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* Intelsat is short for International Telecommunications Satellite Consortium. For the list of members of the Consortium, their ownership interests, and the agreements in force, see the report of the Communications Satellite Corporation, 1967.

of the Pacific, might find a satellite most helpful in communicating with its people, and speeding economic development and the growth of education. Similarly, India, with its huge population, its 560,000 villages, and its problems of illiteracy and multiple languages, might find a satellite of great aid to development. Some of the Latin American countries have indicated interest in a continental satellite. Japan, Mexico, France, the Federal Republic of Germany and Canada, among others, have made plans toward their own satellites, and a decision on a Western European satellite system is expected to be taken in 1968. How should satellites like these, when and if they come into being, be integrated into the world system?

Some of the most bothersome questions have to do with the relation of space to ground communication systems. The radio spectrum is already crowded; the danger of interference with or by satellite communication is very great. When satellites operate over highly developed regions, what patterns of frequency allocations, beam limitations, and radiation levels would most probably avoid interference with the existing microwave relay systems presently used for telephone, television, and other such services? Conversely, how can we keep ground systems - microwave beams, for example - from interfering with the communication to and from a satellite? Both space and ground systems will undoubtedly expand greatly in the next two decades. How can we best plan the development of the satellite system, the frequencies to be given it, and the restrictions upon it, so as not seriously to limit the future growth of ground systems? How can we control the expansion of ground communications so as not seriously to get in the way of future satellite developments? In order for space and ground systems to co-exist, particularly as we move beyond the stage of point-to-point satellites, it will probably be necessary to review the whole pattern of frequency assignments in the radio spectrum.

The problem of television standards is not a serious one as long as programmes are exchanged system-to-system, for the differences in the three existing standards can more or less be taken care of by adaptive circuits. If and when we come to direct broadcasting from satellites, however, the existence of these differing standards would effectively limit international broadcasting.

One of the bothersome problems that is already with us is the question of access to the system. We have already noted that all nations have been invited to join Intelsat, but the cost of participation and use limits realistically the ability of developing nations to take part. The cost of ground stations and system use will undoubtedly come down, but many countries of the world lack their own communication base which would make satellite channels worthwhile for them.

Problems of system design and integration like these are important and difficult, and persons and organizations concerned with the use of satellites for education, science and culture have every reason to concern themselves with them. Yet they are not the direct responsibility either of such persons, or of organizations like Unesco which institutionalizes the world's concern with education, science and culture. Rather, they fall within the purview of governments, commercial entities engaged in international communication, the International Telecommunications Union, and the political and economic bodies of the United Nations.

Nevertheless, it would be of great value to have education, science and culture represented when some of these decisions are being made - for example, when frequency allocations are being reviewed.

Such voices are not often heard when frequencies are being given out or standards determined, but they have been heard on occasion and sometimes with rather spectacular results. For example, the present development of educational television in the United States would never have come about if the educators of that country had not banded together and sent their representatives to the channel allocation hearings in the early 1950's. They were able, against severe opposition, to have a large number of channels reserved for education. These channels are now occupied by 134 non-commercial, non-governmental stations, broadcasting education into schools and homes.

But are we really prepared to state very concretely the needs of education, science and culture for space communication links? There has been relatively little planning and forecasting of this kind, and a projection of the plans and probable needs of the developing countries as well as the industrialized ones would now be most useful. As a matter of fact, some imaginative long-range thinking about the probable communication needs of the world, ten or twenty years from now, would be extremely helpful, even if it proved, like most future projections, to be not entirely accurate. In particular, it would be helpful to have even a rough projection of what the rising educational levels, expanding population, economic development in the newer countries, and the increase in leisure time are likely to mean for such activities as data exchange, news flow, person-to-person messages, cultural exchange and education with the aid of electronic channels. If some guidelines of this kind could be put next to a projection of technical capabilities, then we might conceivably avoid false steps that otherwise might have to be retraced.

Until such projections are available, we are somewhat handicapped in expressing needs for the kind of space communication we are talking about. We know that, in general, there will be a need for increased flow of information of many kinds. We can safely say that the developing countries will need more communication links. We can predict with confidence that the exchange of data by electronic means will greatly increase. We can urge that no system plans be made that would foreclose

the possibility of national or regional satellites to be used for education and national development. But until we have given more thought and imagination to the probable needs and development of education, science and culture, on the ground, we cannot speak very definitely about the needs of education, science and culture in space. This would seem to be a priority for planning.

Concerning access to satellite systems, it should be possible, however, to express a need somewhat more concretely. To a new and struggling country, opportunity to join the Consortium may not appear sufficient answer to the resolution of the General Assembly that "Communication by means of satellite should be available to the nations of the world as soon as practicable on a global and non-discriminatory basis". Even if costs come down, most of these countries have not developed their own communication systems to the point where they could effectively make use of satellite links. Is there not a need, therefore, for a broad programme of technical and economic assistance to help the new and developing countries move into modern communications - step by step, so that as little as possible is wasted: improving the nation's own internal communication system, then regional communications, finally linking up with the global satellite system?

We are in an expanding universe of need for educational, scientific and cultural communication. It is important therefore that present decisions about the international communication system should foreclose the fewest possibilities and open the widest avenues for future developments. But meantime there is a great urgency about defining these needs more closely. What happens to space communication will depend at least in part on how clear a picture of needs we can obtain. It will depend also on man's readiness to use the system for the purposes that are important to him. Therefore, a great deal of "homework" will be required of the persons and organizations and governmental bodies concerned with the communication of education, science and culture.

SPECIFIC USES: EXCHANGE OF DATA

Let us turn now to the problems of bringing satellites into use for certain specific information needs within the limits of this topic.

The opportunity now exists to share data over long distances as never before in the history of mankind. The development of computers of great capacity has made it possible to store enormous quantities of information in digital form, and to search efficiently for and retrieve any part of what is stored. The development of related arts and sciences of indexing, abstracting and programming has brought into being a new force in human affairs, which we describe as information science. Fortunately for us, these developments come at a time when many of the natural sciences are experiencing a glut of research information, when information of great importance to scientists and policy-makers is being produced at many and distant places on earth, and when rising educational levels and expanding scholarships are creating new needs for information world wide.

In this race between information needs and new information capabilities, communication satellites will play only a facilitating rôle, but probably an important one. Indeed, some space scientists have predicted that communication satellites may be used more for data than for telephone transmission. Their function will be to extend the connexion between data sources and user. Already computers have been connected to other computers or to data consoles, over thousands of miles, by means of land lines. They can also be connected by satellite. Weather data have been exchanged, by words, numbers and pictures, over almost all the world, by satellite. Telemetry and even television from satellites have been received on earth from many hundreds of thousands of miles away in space. Can we now adapt these proved capabilities to the needs of scientific and educational information?

Men have dreamed of a new age of information. Great data banks, established centrally, would be available to the most distant users. Scientists in developing countries or at isolated locations would have as ready access to the research in their fields as would their colleagues in the great centres. A sick man in a distant location could count on the help of a great medical centre. There would no longer be a stultifying lag between new knowledge and its dissemination. New findings in medicine, for example, would be promptly available to clinics and hospitals and medical schools everywhere. The effective resources of a small town or school library would no longer be a few hundred or a few thousand volumes, because there would be available by quick data transmission, when needed, the enormous resources of such great information centres as the Library of Congress, the British Museum, or the Lenin Library. National, and ultimately international, information systems would come to be realities, and computerized indexing and cataloguing would take much of the drudgery out of working with them.

Let us not mistake the dream for present reality: we are far from being able to make that kind of dream come true. We are still very far from having the computer capacity and strategies even to computerize a great library, like those just mentioned, for ready use. But we can already do remarkable things in using computers for information storage and retrieval, and it is safe to say that whatever we can store on a computer we can transmit and retrieve at the end of a satellite circuit.

Most of what remains to be done, in data exchange as in other uses we shall discuss in this paper, must be done with the ground system rather than the space components; and most of it does not even involve hardware development.

Present needs, as we move toward full use of satellites for scientific and educational data transmission, are to establish the needs for such data, the locations where the data exist, the forms in which it must be packaged in order to be useful, and the institutions and organizations which must come into being in order to collect and disseminate the data. This is planning of a high order which

must involve many parts of the academic community and the information professions.

International data exchange will require building up national capabilities for information exchange. Indeed, among scientists, physicians, librarians, educators, a great deal of work is already under way in a number of countries to assemble and index needed data, using computers wherever possible; and to provide abstracts, and build procedures and organizations for disseminating. The increasing development of abstracting services at national and international levels in many fields of learning is evidence of this activity. So also are the numerous projects in computerizing library services, and the existence of high-level committees and commissions in some countries trying to match the needs for information with the new capabilities for providing it. Some of these scientific information systems try to collect research results world wide. Information scientists from different countries have already taken steps to share developments in information technology. The impetus is coming chiefly from countries where data needs are great, and where the systems of gathering and exchanging information are relatively far advanced.

How can an organization like Unesco best contribute to this growth toward international data exchange, in which communication satellites will ultimately play a considerable part? It seems to this writer that the greatest contributions might come: (a) in helping to share with the smaller and newer countries what is being found out about information technology and dissemination, and (b) by facilitating in every way possible the planning for truly international data systems. The joint ICSU[1]/Unesco Project on the Communication of Scientific Information and the Feasibility of a World Science Information System is an important step toward meeting these objectives.

The central committee designed to supervise the ICSU/Unesco Project could serve as the nucleus of a commission or advisory group on information exchange, to inform Unesco and other interested parties of the most advanced work under way in each of their countries, and to identify the points of common planning that must be undertaken before truly international data exchange can come into being. It could identify reports and bibliographies that would keep the newer countries informed on developments and possibilities of interest to them. The commission itself would have on its agenda questions like these - some of which, of course, are already being considered by existing agencies or groups: What are the priority needs for information exchange in science and education? For which of these do the data already exist, and if so where, and for which ones must new data be gathered? Which needs must be met by original documents, including books, and which can be met by computerized or abstracted information? What activities are under way in various countries to meet these data needs and, in particular, what methods are being discovered to make the collection, indexing, storage, retrieval and dissemination more efficient? To what extent are the systems developing in different countries compatible, so that information can easily be transferred among them? What national base for information collection and transfer must exist in a country if it is to make proper use of and furnish proper support for an international data exchange, and what international system will be needed to properly feed such national systems? What part of the international exchange can best be handled by electronic, and what by slower means? In designing a very large information system, what should be the relative emphasis on centrality and decentralization? For example, how many great resource libraries or data banks will be needed? What institutional arrangements will be necessary for efficient international exchange? And, looking toward the future, what forms and structures for gathering and packaging data should now be developed nationally so that they can fit with least dislocation into an international system? Some of the needed data will be collected in the course of the feasibility study mentioned above, and if the system comes into operation it will take over many of the tasks named here.

International information exchange will undoubtedly become a very large activity. It may be, as Campbell predicts, that a new United Nations Specialized Agency or bureau will have to be organized to handle it.[2] Meanwhile, however, such an activity as has just been suggested, will help to eliminate waste motion and point the way toward whatever international structure is ultimately required.

SPECIFIC USES: NEWS TRANSMISSION

Communication satellites offer an opportunity to increase and even out the flow of news in the world. It has been amply demonstrated that news flow falls off markedly with distance (geographical or psychological) and that the flow is overwhelmingly from the more developed countries to the less developed ones.[3] Even in the countries where most news is available, a disappointing amount of it covers distant areas chiefly in terms of crises or features (war, threats, snake charmers, movie stars, and two-headed calves, someone has said).

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(1) International Council of Scientific Unions.

(2) H.C. Campbell, Some Implications for National, Public and Research Libraries of Communication Satellites. Paper for Unesco Meeting of Experts on the Use of Space Communication by the Mass Media, 6-10 December 1965. Duplicated by Unesco, Paris, 1965, p. 8.

(3) W. Schramm, Mass Media and National Development. Stanford and Paris, 1964, pp. 58-89.

If a newspaper or broadcast news editor wants to cover world news in terms of two-headed calves and movie stars, an increased news flow is not likely to make much difference, but at least alternatives will be readily available. And experience has shown, as Ray has pointed out, that whenever cables have been extended to a country there has been a notable improvement both in the speed and quantity of news available to readers and listeners in that country. Therefore, there is reason to believe that satellites can potentially make a real difference in news availability throughout the world.

In theory at least, this should occur at each stage of satellite development. In the relatively distant years of direct broadcasting, we may be able to look forward to facsimile newspapers broadcast directly into the home, and perhaps even to some choice as to what part of the news one wants to have printed out on his facsimile machine. That stage of development should also make a difference in the kinds of news organizations that serve the home. For example, international newspapers could become a reality, and in very large countries national newspapers could circulate much more easily than now. There might be a merger of some newspaper and broadcasting news units into a broader kind of news service, combining the sense of receiving "instant news" that television offers with the greater depth possible in print and facsimile. There is little doubt that if and when direct broadcasting from satellites becomes readily available, it will shake up our news system as it will shake up our present television services.

In the stage of distribution satellites, it may prove feasible for news agencies to serve some scattered clients directly, and thus overcome the lack of telecommunication links or high rates of ground transmission.

Much of the effect on news transmission, however, may be felt even at the early stages when most satellite communication is point-to-point. One of the characteristics of satellite communication is that the use of the space link should cost about the same regardless of the distance the message travels, providing that it is within the satellite's effective coverage area. This area can be as large as 40% of the earth's surface. To any newsman, this suggests one of the famous chapters in the history of news transmission - the British Empire rate, which made it possible to send news copy for 1 penny a word, from any part of the Commonwealth to London, regardless of the distance travelled. This rate was much cheaper than any corresponding press rate, and succeeded in moving a very great amount of news.

Wide differentials now exist in press rates throughout the world. Some of these are related to distance; some are not. The very high cost of sending news from some countries to others considerably depresses the amount of news that is actually transmitted. This suggests the attractive idea that perhaps something like a flat rate (or an an almost flat rate) for news, regardless of distance, might be established world wide thanks to the peculiar economic qualities of satellite transmission. If this were possible, it would help to even out the flow, and thus help to equalize the opportunity for one part of the world to know about other parts.

Similarly, satellites will sooner or later offer a chance to develop reliable teletype news service by radio to parts of the world where radio reception is not now reliable. They also offer an invitation to experiment with facsimile. There were a few small trials of facsimile newspapers in the 1940's and early 1950's, but they proved not to be financially feasible. Since then, the method has been improved and used for the transmission of numerous kinds of pictorial material, including newspaper pages for offset reproduction. Satellites extend these capabilities farther and invite the news media to review the question of what news functions might in the future be carried on by facsimile.

For television news, point-to-point satellites offer an opportunity to transmit news films and sound tracks more quickly and probably more cheaply. One major American network has announced that it plans to establish "self-contained news bureaux ... complete with equipment and production crews for transmitting fully prepared stories" around the "main gateways for satellite communication" - meaning principally the countries with ground stations.(1)

The international news agencies and many national press associations are well aware of the potential of satellites for news transmissions, and ten of these organizations have formed a joint committee, with a secretariat, in London. One of the keenest observers of the press has suggested that a joint advisory board should be formed, including the committee just mentioned, the International Telecommunications Union, the Communications Satellite Corporation, other organizations that may be responsible for launching communication satellites, and Unesco. This board, he suggests, should be responsible for examining all means by which the world flow of news could be improved through developments in space communication.(2)

The contribution of Unesco to bringing satellites into use to assist the flow of world news might take the form of bringing together such a group as this, representing as broad as possible a spectrum of news media, news agencies, and space communication, at first on a one-time basis, later on a continuing basis if that proved desirable. In such

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(1) Walter D. Scott, A Perspective on Global Television. Address to the Detroit Economic Club, 6 February 1967, p. 6.

(2) Lord Francis-Williams, The Transmission of News. Paper for Unesco Meeting of Experts on the Use of Space Communication by the Mass Media, 6-10 December 1965. Duplicated by Unesco, Paris, 1965, p. 8.

a group as this, Unesco could provide: (1) an international platform on which the news needs of all countries, large or small, could be represented, and from which the news media of all countries could be made aware of developing plans and opportunities; (2) liaison with on-going developments in other areas of space communication, such as legal problems and plans for using the satellites for educational purposes; and, finally, (3) an encouragement to plan with an eye on the long-time future when different satellites will be in operation and different services will be possible.

SPECIFIC USES: CULTURAL EXCHANGE

It is reasonable to assume that most cultural exchange via satellites will be in the form of television, and that as long as we have point-to-point satellites there will not be much of it. Most programmes, except spot news, sporting events of wide interest, or great historical events can be exchanged just as appropriately on films or videotape carried by jet airplane, as by satellite. In fact, many cultural programmes, such as opera, ballet and drama, are relatively timeless, and can be transmitted by almost any means. A complicating factor, however, is that if it proves impossible to negotiate for other than live transmission of certain art and entertainment events (for example, some music festivals) an exchange by films or videotape might be infeasible.

Yet the televising of great events by satellite, the occasional live programme (for example, the 25 June "Our World" programme seen in Europe, North America, Mexico, Tunisia, Australia and Japan, and the sporadic "Town Meeting of the Air" programmes of discussion between Europe and America), along with the increasing amount of travel in the world, are building appetites for foreign television, and if satellite charges continue to decrease we may expect to see more foreign television via satellite. There may be still more of it when distribution satellites come in, and offer the opportunity to use evening hours on an educational satellite for general programming. But the real impact of satellite culture exchange will come, if at all, when direct broadcasting satellites are operative.

We can only speculate now as to what these will do to television services. It is safe to say, however, that they will offer the opportunity for more television in any given place, and consequently more alternatives and more specialized services if these prove to be desirable. It might be possible, for example, to use one satellite channel for carrying United Nations or national legislative sessions, another to carry high culture, like the BBC Third Programme on radio, still another for sports, and so forth. Also, the opportunity will be there for international television, if the barriers and objections to it can be overcome. It is not beyond belief that, twenty years from now, television from several continents, along with a facsimile newspaper, might be readily available, in any home where there is a receiver.

This may not be entirely desirable. For example, if satellite television were readily available, there would be less need of local stations and less support for these stations in local markets; therefore, less attention by television to local problems and needs, less opportunity for audiences to express their wishes and reactions to the station. Satellite programmers will know less and less about their audiences and may be forced into more and more innocuous programming in order to meet a wide variety of tastes and avoid offending a wide variety of sensitivities.

Satellite broadcasting over a very wide range is certain to come up against the problems of national sovereignty and national cultural sensitivity. What is a documentary to one country may be propaganda to another country. What is great literature to one country may be offensive to another. What is history to one country may be provocative to another. Even what is education to one country may be contrary to the norms and beliefs of another. In any wide-area satellite broadcasting there is likelihood of unintentional overlap of coverage areas, as well as opportunities for intentional propaganda to other countries. Along with this, consider the peculiar vulnerability of a satellite to hostile action. It is relatively easy to jam the communication link to the instrument, and in some cases even to take it over at times for one's own messages. It is also within easy possibility to break the signal code by which the satellite is turned on or off, or by which the jets are operated to keep it in position. Therefore, it is conceivable that a nation offended by a satellite's transmission might simply turn on the jets to move the satellite out of orbit and destroy it. It is clear that the world can hardly enter into this direct broadcast stage of cultural exchange until the institutions and patterns of co-operation, the mutually agreeable codes of programme conduct, and the arrangements for control of programme content and redress of grievances, are all carefully prepared.

Every public communication system requires controlling patterns and institutions so that its uses and content will be consonant with the norms of the society it serves. It is precisely because different nations of the world have different norms regarding freedom of information that satellite communication represents a difficult control problem. The more international communication the satellites carry, and the more they are used for communications other than person-to-person telephony, the more necessary it will become to surround the satellite system with a pattern of law and orderliness and some institutional arrangements to manage the control problems. If these arrangements are not in working order by the time we are ready to begin direct broadcasting from satellites, then we shall face a very dangerous situation.

Point-to-point communication by satellite is unlikely to challenge national sovereignty, and domestic legislation will provide recourse for individuals or organizations who consider themselves to be injured by satellite transmissions. Some problems may arise from differing national legislation on libel and breach of privacy, and the rights of performers may have to be redefined or reconsidered on an international basis if their performances are made public in a number of distant countries. At present these international arrangements are typically made by the broadcasting organizations of the nations involved. The more countries involved, however, the more attractive some broad, general arrangements will come to seem. Copyright, too, may present some problems. But because a country's own communication system serves as a gatekeeper to transmit or retransmit whatever passes over the satellite system, most of the problems will be within domestic jurisdiction and require no special international arrangements. There is some danger, of course, that the power to transmit and retransmit may come to be surrounded by such a maze of restrictions and controls, in an effort to protect the norms or policies or "image" of a country, that very little will go through. The amount of control to be exercised over content transmitted or retransmitted is therefore a problem of international understanding which should be solved, or at least clarified, even for point-to-point communication.

The closer we move toward direct broadcasting, the more imperative it will become to approach from an international basis the problem of preventing abuses of the new capability for international communication. It is predictable that efforts to establish an international legal system for information will be resumed, at or near the point where they were carried by the 1948 Geneva Conference. Some institutional arrangements to carry out control agreements will doubtless be required. Terrou has spoken vigorously about "the dangerous gulf that is forming between scientific progress and the stagnation of institutional arrangements ... Scientific and technical advances themselves, at any rate from the point of view of their social application, may be held up, jeopardized or ... transformed into a source of danger unless we are ready, here and now, to make those institutional arrangements which will induce the community of nations to accept such advances by ensuring that they will be made to serve the common weal. The problem must therefore be stated unequivocally. It is a problem which can be solved by only two methods - force or law, coercion or international co-operation. Coercion would mean arbitrary jamming, it would mean the destruction of instruments for the dissemination of information, a ban on the manufacture, importation or even possession of receiving sets. Co-operation means legal solutions - international agreements and regulations whereby the various States and, through them, the bodies responsible for the production and dissemination of space information would accept a discipline and responsibility calculated to prevent abuses and every kind of infringement of those community and individual interests which are recognized by law in each national community".(1)

Space law seems to be evolving within long accepted outlines of international law. Goldstein, for example, has noted that at the time of the International Geophysical Year all nations agreed by common consent to an evolutionary step of such importance that it might be considered a part of the "common law of mankind": that outer space may be used for peaceful and scientific purposes without restrictions based on terrestrial sovereignty.(2) A second principle, the basic right of a nation to defend itself from attack, whether from the ground or from outer space, is embodied in Article 51 of the Charter of the United Nations. It points to the obvious need of defining what in the field of information constitutes an "attack", and providing controls and opportunity for redress. A third principle is that of orderliness in space, illustrated by the international agreements already arrived at for use of the radio spectrum which, like space itself, is conceived of the common property of mankind. It is desirable now to devote major attention to defining these developing norms in practical terms.

But a professional code typically requires a professional body to administer it. A set of rules or regulations, or a body of law, is of little value without enforcement and administration. Therefore, it is necessary to consider the kinds of international institutions and arrangements that would be required to maintain a rule of law and order in space broadcasting. The developing situation being what it is, this institution should be designed not only to administer an existing code, but also to meet a series of unforeseen problems and challenges as human experience in space unfolds.

How can we begin to move toward the goal of very wide exchange, even where the pattern does not now exist? The European Broadcasting Union has its own exchange organization, Eurovision, and the nations of East Europe have a parallel to it, Intervision. One reason why the prospect of a distribution satellite is so attractive in Europe is that a firm basis already exists there for the exchange of programmes. There is also provision in the Far East. No such regional exchange organizations exist, however, in Africa or the Americas.

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(1) Fernand Terrou, International Co-operation in the Use of Space Communications for Information, Education and Culture. Paper for Unesco Meeting of Experts on the Use of Space Communication by the Mass Media, 6-10 December 1965. Duplicated, Unesco, Paris, 1965, p. 9.

(2) Sydney Goldstein, International Co-operation in the Field of Aviation Law. In World Peace through Law, pp. 494-495.

In the case of this problem, as with others we have talked about in this paper, there is much to be done on the ground before we leap into space. It is suggested that the place to begin is in encouraging intercultural co-operation among broadcasters, as it has been encouraged in Europe, quite apart from any consideration of space links for this exchange. At the same time it would be useful to try to understand some of the problems involved in such co-operation, and how they may be overcome.

Unesco has begun to collect some of the experiences of regional organizations with exchange of programmes. This is a sound and practical step and should furnish some guidance both for new regional organizations and for co-operative efforts on a world-wide scale.

The Chairman of the Board of the National Broadcasting Company (United States) has advocated a world-wide association of broadcasters. Nothing less than that, he says, "can provide a wholly effective nerve centre to serve emerging needs rising from television's rapid global growth. These include the need, not only for a central file of programmes available for purchase or exchange, but for a clearing house to deal with such factors as time differentials, copyrights, union arrangements, scheduling clearances and simultaneous translation. Major long-range planning, as well as day-to-day co-ordination, will be required if anything approaching Eurovision is to be attempted on a global scale. The closest kind of technical liaison will be needed. A fertile field for a world-wide broadcasting organization lies in the development of uniform measures affecting artistic, business and labour interests and rights in connexion with internationally televised material. A world organization could provide personnel exchanges and training courses so that the skills of advanced broadcasters are made available to their counterparts in emerging nations ... . We realize that establishing any international organization is a complex task. Yet the need for free expression and open channels among nations is so great that we must not leave the challenge unmet."(1)

Most of the requirements for programme exchange cited in this statement are also requirements for programme exchange by satellite. Therefore, anything that can be done to strengthen the programming capabilities of new television systems, or to encourage regional exchange will ultimately contribute to world-wide exchange. Furthermore, it is apparent that much international exchange of cultural programmes can and will take place without the use of satellites, and therefore if regional and then world-wide exchange can be facilitated in general a certain part of the practice will merge into exchange by satellite.

This would then be a step toward meeting the problems of direct broadcasting by satellite. At least, the habit of co-operation would be set up, and various forms of it - for example, the joint planning and production of a programme - would be tried out. Such hard problems as performers' rights and copyright would be aired.

Problems like these might be the next place where Unesco or other appropriate organizations could help pave the way toward direct broadcasting of cultural programmes by satellite. The question of copyright, as affected by satellite transmission, needs to be studied. The Buenos Aires round table of 1964 on Legal Systems Governing Satellite Communications, as reported by Armando Cocca, concluded that an extension of the present copyright convention would provide adequate protection.(2) The rights of performers will present more complex and difficult problems in the satellite age, and the Berne Convention, as revised at Rome in 1961 and at Stockholm in 1967, clearly needs re-examination. When it is decided what modifications, extensions, or replacements of these agreements are desirable, then new instruments, if needed, might be drafted by the appropriate parties and brought to the attention of governments.

Studies and possible agreements of these kinds would be easier than the ultimate problems of control and organization which must be met before direct broadcasting becomes a reality. Yet at the appropriate time these too can be faced. Whether the problem of freedom and control, as applied to space broadcasting, is taken up as an extension of the 1948 United Nations sessions, or otherwise, it would be desirable to stimulate preparatory dialogue. Arthur Larson, an international legal scholar well acquainted with broadcasting, counsels that "in today's embittered international situation there is little hope of achieving a general international convention for outlawing the publication of false reports and the proscribing of defamatory, subversive and war-mongering communications". Instead, the emphasis on planning toward a treaty or code might well be on "the creation of the right to reply and correction; imposition of a duty to pass domestic legislation curbing excessive propaganda by individuals; and possibly the establishment of dispute-settling procedures between the parties in matters of propaganda".(3) It is interesting to note that the Nordic broadcasting organizations have already accepted common rules on the right to reply and correction.

The preliminary dialogue on organization for direct and co-operative broadcasting could also begin long before political action would be needed, making use of all the experience with co-operation in ground broadcasting. Precisely what kind of administrative structure and power of enforcement

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(1) Walter D. Scott, op. cit., pp. 11-12.

(2) A.A. Cocca, Space Communication and Cultural exchange. Paper for Unesco Meeting of Experts on the Use of Space Communication by the Mass Media, 6-10 December 1965. Duplicated by Unesco, Paris, 1965, p. 12.

(3) Arthur Larson, Propaganda. New York: Oceana, 1964, pp. 229-30.

will be needed? What kinds of programming can best be done by a nation for others, and what kinds can best be done by several nations in co-operation or by an international programming organization? If questions like these can be thoroughly aired before the solutions must be decided upon, they can perhaps be handled with less heat.

We may be exaggerating the potential trauma of direct broadcasting. Changes in communication have a way of following powerful new technologies. It might be that the attractions of space broadcasting will be so great that the problems will shrink. But that is not what practicing broadcasters and international legal scholars believe. They feel that a high degree of co-operation, tolerance and restraint, along with suitable agreements and administrative machinery, will be required if direct broadcasting from satellites is ever to be anything other than a piece of science fiction or a non-fictional fiasco. The reason for approaching these problems today is that they will certainly be far worse tomorrow.

SPECIFIC USES: EDUCATION

No use of modern communication has so interested the planners in developing countries, and other individuals and groups concerned with economic and social development, as the possibility of using it in support of education.

The possibilities are indeed attractive. For countries where well-trained, well-educated teachers are in short supply, there is the chance to share the best teaching widely. For countries where schools are short of teaching aids, there is the chance to distribute audio-visual materials and demonstrations from central places. Where special courses or special kinds of instruction are needed, there is the chance to produce it in one place and distribute it to many. Teachers can have access to continuing in-service training without having to go back to the teachers' college for it. Where schools do not exist, education can still be carried by broadcast and correspondence study. Where literacy classes are needed, basic material can be offered by broadcast or films, and a monitor not specially trained for literacy teaching can conduct the class. Films and television can speed up the learning of mechanical and electronic skills. Broadcasts in support of rural forums, teleclubs, village level workers, or agricultural extension, can help impart needed knowledge of health, agriculture, or community development. And in all these uses, modern communication can help to broaden the perspective of its users - beyond the village, beyond the State, beyond the nation - and implant ideas of how other people live, of the national plan and purpose, and of the changes under way.

Modern communication, of course, includes all the media, and all are useful in one way or other. In developing educational systems, however, modern communication has most often meant radio, television and films, and the most dramatic uses of these - because of their ability to multiply communication resources and distribute them simultaneously over large areas - have been with radio and television. These have included, for example, television and radio in schools (as in Samoa, Niger, Colombia, Thailand), radio in combination with rural forum groups (India and Togo), radio or television combined with correspondence study (Australia and Japan), television with literacy study groups (Italy and the Ivory Coast), teacher-training programmes (in many countries). Projects like these have attracted wide attention and whetted appetites. And because television and radio have played such a large part in all of them, the question has inevitably been raised whether a communication satellite could not do better, and perhaps more cheaply, over a far greater area, what radio and television have done in limited areas.

A point-to-point satellite, of course, could not contribute much to an operation of this kind. A distribution satellite, at least, is required, and, if possible, a satellite that would have some capability for both direct broadcasting and distribution. For example, preliminary cost studies indicate that for a country like India where television exists in only one city, where telecommunication is not well developed, and where perhaps one-fourth of the population could be reached by television stations in the large cities, the least expensive way of bringing television to most of the country would be a combination of rebroadcast and direct broadcasting from a satellite.

If a distribution satellite could be used in a developing country, it would, in effect, take the place of microwave links or long lines to local stations, and the country could, for the time being, forego that expenditure. If the whole country could be served by direct broadcast, it would be possible, if desired, to leap over the stage of building local stations.

A considerable part of the ground cost, however, could not be avoided in any case. Receiving sets and antennae would be needed. Electric power would have to be available, either generated locally or supplied from some regional source. There would have to be provision for maintenance in the villages as well as the cities, and a number of electronic components and units (including sets) would either have to be manufactured or purchased with foreign exchange. In Samoa, to take one example, it was found that new schools had to be built before television could be effectively introduced. For any large country, the cost of the ground segment would probably be considerably more than that of the space segment. And the annual operation of the ground segment of the system would be very much more than that of the space system. It would include the programming, the maintenance, the very extensive arrangements for co-operation and

liaison between schools and programme centres, and the materials that would have to accompany the broadcast instruction.

Just as television is a mass medium and has to be used in a large way if unit costs are to be acceptable, so a communication satellite is a very large telecommunication system which has to be used to serve a great area lest the unit costs be out of reach. "A little" use of a satellite system for education and economic development is therefore not a reasonable policy for a developing country. Any such use involves a major investment in money, manpower and technical resources.

This is not to say that such an investment is not justified. Rather, the point we are trying to suggest is that it is probably justified for some countries, under some conditions, at some stage of development.

One of the touchstones is the size of the country. For unit costs to be favourable, in comparison with other ways of delivering a signal, the country must be a very large one - perhaps something of the order of a million square miles in area - or the satellite must be used to serve a co-operating group of countries. For educational use of a satellite, however, this raises the question of local needs and local patterns of education.

One of the essences of education is localness - individual differences among students and consequently different needs for instruction; local class schedules and local curricular patterns; differing content of courses based on local interests, surroundings and occupational goals; differences in standards of accomplishment between schools or regions; different customs; sometimes different languages. These differences are much greater in some countries than others; in France, for example, there is greater uniformity of curriculum and standards than, for example, in the United States. The same problem carries over to adult education and development information. For example, dry wheat farmers will be very little interested in the kind of advice to be given wet rice farmers; the fishermen of Kerala would gain little from instructions broadcast to Rajasthan about the diseases of camels.

Therefore, any country thinking of a satellite for educational uses must ask what material can profitably be broadcast to the entire region served by the satellite, or what division of satellite time or of satellite channels (if it has more than one) would meet the different needs of different parts of the region. If a group of countries plan to use the satellite together, they must ask the same question in terms of their differing needs.

Where television has been used for education, it has been found that a great deal of its effectiveness depends on the kind of activity that is stimulated at the receiving end. Learning activity is stimulated in part by the broadcast, and in part by the classroom teacher or monitor. Some of the most effective television teaching encourages pupils to be quite active and responsive during the lesson, and leaves them with curiosity and interest they want to satisfy after the broadcast. The classroom teacher must prepare the children for the broadcast, and afterward take care of their questions, and build, around the broadcast, appropriate practice and demonstration, individual learning and study activities. In many of the most successful television projects the classroom teacher performs as a true partner of the studio teacher; in fact, it becomes a kind of team teaching, in which the television teacher does a part of the job, and the classroom teacher another part. To accomplish this, both teachers must learn new rôles. The feeling of being on the same team comes usually from common planning, or from very close liaison and constant feedback from the schools to the studios. It comes also from skilful administration which removes the threat and resentment from the classroom teacher at having her classroom invaded and helps her learn the new rôle she must play. This is a very subtle problem, because a disgruntled classroom teacher, or one who is not co-operating with the studio teacher, can very easily cancel out all the advantage of putting an expert teacher on television.

This kind of problem will be even more demanding when a satellite is put into the communication chain. It is harder to bring all teachers into the planning, to keep up liaison and feedback, and to pitch the broadcast at a level that will stimulate all classrooms. At the very least, therefore, educational use of a satellite would require very careful and skilful administrative planning, a considerable effort to assist the classroom teacher to learn her new rôle, and a large staff of field workers, supervisors, and counsellors to maintain contact between central administration and programming, and the schools and classrooms. In a country large enough to use a satellite expeditiously - that is to say, a country like India, Indonesia or Brazil - that field staff would probably number in the thousands. For adult education the broadcasts would have to be combined with a field staff and organization even larger - perhaps something of the order of India's 35,000 village-level workers. If a group of countries use a satellite for education, they will almost certainly need an international organization to plan and co-ordinate programmes and provide for liaison with users.

A country that is considering the use of a satellite for education must neither be frightened away by difficulties like these nor carried away by the heady prospects. Rather, it must ask some very hard questions about whether its educational problems are better solved in the future by a satellite system or by some other solution - for example, ground-based television, or an expanded and improved programme of teacher training. And if the satellite looks sufficiently attractive, then the country must ask what steps it must take to prepare for the satellite system, and whether it is prepared to take those steps at once or to schedule them over a period of years.

For example, suppose a country concludes after careful review that it should move towards use of an educational satellite. It cannot make this plunge at once. There will be some curricular changes to consider. What courses can best be assisted by mediated teaching from a distance? What changes, if any, should be made in the content of those courses and the methods of teaching them? For example, if mathematics and science are in the list, is this the time to introduce the "new math" or the new science curricula?(1) What printed or duplicated materials will be needed for these courses? What must be done about revising schedules so that the broadcast teaching can be received at the same hour throughout the area to be served?

When these preliminaries are done, the country may wish to move into instructional television on a small scale, so as to gain experience with it. This will require the providing of power, receiving sets, and maintenance facilities, as well as a broadcasting station and trained persons of several kinds. However, such a step will let the schools try out the new courses so that they can be revised before the country commits itself to them on a broad scale. Prospective studio teachers can gain some practice with their art, and schools can experiment with different classroom practices related to the broadcasts. At this time, also, something can be learned about how to maintain liaison between schools and studios, and what kind of assistance both the classroom teacher and the studio teacher will need.

At the same time, the community development, adult education, health and agricultural agencies can begin to use the television system in out-of-school hours, so as to find out what tasks it can best do for them, and what skills and supporting activities it will require.

While this is going on, the country will want to build up a cadre of trained persons. Some of these will be engineers and technicians to operate the broadcasting equipment and maintain the sets; later, there must be persons to operate the satellite ground station. There must also be programme and production personnel for the studios and educators who know enough about broadcasting to manage the school side of the operation. One of the advantages of starting in a small way with ground-based television, rather than a large way with a satellite, is that a cadre of trained people can be created, from formal training, from observation of other countries, and from experience, to serve other areas and larger responsibilities.

With this kind of procedure, nothing is lost with each new step. The curriculum is reviewed and improved. A nucleus of trained and experienced people is being created. Instructional television is operating in at least one region, and enough is being learned about it so that the country can decide whether it wants to go ahead with it, and where it is likely to be most useful. It can either cut back, or expand television on the ground; or, when it feels able to provide the financing, the ground installations, and the personnel, it can jump into satellite communication.

If we want to help bring satellites wisely into use for education, therefore, one of the most useful things we could do would be to make it possible for some of the most interested countries to take the first step: that is, to conduct planning reviews of needs, resources, alternate strategies, and technological possibilities. These reviews could be undertaken with the aid of outside experts, if needed. The purpose would be to place a clear picture of educational needs against a consideration of available technologies, so as to answer the primary question, from the country's own point of view, of what technological aids, if any would help advance the educational plans; and the secondary question, would a satellite be a desirable and feasible solution to these problems in the foreseeable future, and if so, what steps must be taken, at what cost, into the satellite age?

The 1961 meeting of the General Assembly invited the United Nations Special Fund and Technical Assistance to lend a "sympathetic ear" to requests from Member States for surveys of their domestic communication facilities. The Expert Advisory Committee appointed to follow up the 1963 United Nations Conference on the Application of Science and Technology for the Benefit of the Less Advanced Areas, recommended that, whereas "media are now being increasingly used in the developed countries ... they will require considerable and perhaps fundamental adaptations if they are to be applicable to the need of the developing countries ... . Clearly, for such countries, the initial step should be a survey of existing needs and resources and the devising of methods and media by which such available resources as exist can best be adapted, employed and supplemented to meet local conditions and needs."(2) Not much has come out of these recommendations, and actually the amount of money that has gone from United Nations sources into bringing the media into use for education has been relatively small. For example, about 35% of loans from the International Bank for Reconstruction and Development have been

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(1) A time of impending change is the best time to review the goals and means of an educational system, against the national goals and the available means. Thus, there is a very close relationship - or should be - between planning for new technology and planning for new curricula and more efficient teaching methods. As Jerome Bruner has said (Inquiry, ed. by Wilma McBride, Washington, 1966, p. 58), "for the future of TV, the worst mistake would be to put it to work sanctifying the traditional".

(2) Advisory Committee on the Applications of Science and Technology to Development, Second Report, May 1965. Economic and Social Council, Official Records, XXXIXth session, Supplement no. 14.

for transport, whereas about half of one per cent have been for development of communications. The question now needs to be raised again, in light of the coming availability of satellites for the purposes of education and development, whether such step-by-step approaches to modern communication, based on careful review and planning, should not be encouraged and supported.

A second action that would contribute to efficient use of communication satellites, and also to some of the intermediate steps toward satellites, would be to maximize our understanding of the most efficient patterns of television and other new media use for education and development. We mention television especially because it is likely to be a main component of a satellite system used for education, and because we are beginning to see examples of its use for educational purposes in numerous developing countries under different conditions and in different ways. Twenty-three case studies of the use of new media for education have recently been published by Unesco and the International Institute for Educational Planning.(1) This is at least a beginning. Experimental data are beginning to become available on new media projects. These should be gathered, collated, interpreted, and made available to prospective users.

This is particularly important because there are great differences in the effectiveness and the costs of the new media in different situations and different patterns of use, and undoubtedly even the most effective methods can be improved upon.

At the appropriate time, it would be helpful to have a pilot study in which the problems and results of an educational satellite could be identified and studied in the realistic setting of a developing country. It may be possible to find a country where a long jump into satellite communication would be justified. More likely, the satellite stage will have to be preceded by a series of short steps and developments to prepare the schools and gradually improve the ground communication system, train the necessary people, plan the curriculum and the organization, and so forth. In any case, whether a long jump or a series of short steps is indicated, they should follow a careful planning review of the kind suggested.

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(1) W. Schramm, P.H. Coombs, F. Kahnert, J. Lyle. The New Media: Memo to Educational Planners. Paris, Unesco, 1967.

A PATTERN OF ACTION

A pattern emerges from this paper.

The nations of the world are unlikely to plunge suddenly into the use of communication satellites for education, science and culture. Rather, this is likely to happen in a series of preparatory steps. Most of these will involve preparing the ground segment of the communication system to use the space link. In some cases, the actual installation of the space segment may come almost as an anti-climax after all that has to be done on the ground to get ready for it. In the field of data exchange, to take one example, the task of creating a network of data centres, providing for the collection of needed data, and for methods of indexing, abstracting, storing and retrieving, and circulating it, and, finally, for building up the necessary relationships between data centres and their users, will clearly be the major effort, and the satellite will be relatively easy to add to the system when those preliminaries are completed.

In each of the four areas discussed in this paper, we have tried to suggest some of the steps that must be taken for measured and rational progress into the satellite age. If these preparatory steps are planned wisely and taken when needs are evident and resources are in sight, then the stress of change will be minimized, the speed of development will be steady, and each step will be in itself useful. If a country hurries into satellite communication without adequate preparation, it is likely to find itself making false steps, wasting resources, and risking a failure when and if it actually comes to the satellite stage.

The strategy of helping to bring communication satellites into use for education, science and culture - and, we venture to suggest, a strategy that Unesco and other appropriate United Nations agencies should consider seriously - is to facilitate this step-by-step approach.

We have suggested a number of ways in which this facilitation might occur in different areas. They fall into a few general categories: there should be help and encouragement in planning; international co-operation in exchange and in framing necessary understandings and agreements should be facilitated; and information necessary to understanding and moving into the satellite age should be made easily available.

Planning. This appears to be essential in every field of potential satellite use we considered. One of the things to be done is to make it possible for a number of developing countries working toward educational satellites to conduct intensive planning reviews of educational goals, resources, problems and possible strategies, against the possibilities of available technology. In the field of data exchange, there must be continuing planning and review of the needs for data and the shape of a system to meet those needs. The organization of programme exchange will require some planning, both world wide and in regions where no relevant organization and little actual exchange exist. As satellites bulk larger in plans for the circulation of news, here also there will need to be continuing consultation.

Co-operation and agreements. In the field of cultural exchange, particularly, this seems to be the way to move toward the direct broadcast satellite: to encourage co-operation and exchange across ever-widening areas, to encourage constructive discussion of the problems of control and orderliness before these can be seized upon as battlegrounds, and at the appropriate time, to move toward agreements aimed at law, order and mutually acceptable conduct in space broadcasting. The same problem appears, but to a lesser degree, in the other fields we have discussed. In education for example, a plan for a continental educational satellite or for an educational satellite that unintentionally reaches beyond the border of the country it is intended to serve, will call for exercises in co-operation and restraint. If data exchange is to proceed internationally, here, too, we must find how to co-operate efficiently.

Information. In all these fields, Unesco or other organizations can perform a real service by helping to inform countries, organizations and individuals concerned with the educational, scientific

and cultural uses of communication satellites. This implies meetings, publications, some continuing working groups, and perhaps demonstrations. The advances in information storage and retrieval, and the possibilities of and plans for data exchange are kinds of information that would be extremely useful in places where they do not readily circulate. News media and news agencies will need to be able to look into their own future in terms of developments in satellite use and in related areas such as the developing communication law of space. Broadcasters, looking toward world-wide exchange should profit from knowing of the experience of regional organization in exchanging programmes, and the solutions they have found to the related problems. National educational systems, thinking of a possible satellite in their future and of technologies they might adopt preparatory to it or short of it, would benefit from a continuing report and analysis of the experience of other countries with the new media. And as the needs of nations for educational, scientific and cultural space communication become more evident, it will be important for some agency or agencies to serve as an informational middle man, representing these needs to the agencies and entities which are working on system design, and reporting back to interested nations the implications to education, science and culture of the system decisions that are being made.

Thus we find ourselves very close to the viewpoint of Gaston Berger, the remarkable French philosopher-educator whose resolution adopted by the Unesco General Conference in 1960 has motivated many efforts to bring the new media into use in developing countries. Berger was not afraid of the rapid progress of science; he welcomed it, and saw the new technologies as offering perhaps the only opportunity for the new countries to reach their educational goals in the time they felt they could take. But he advocated that we plan from needs and objectives, try to find new methods of meeting them, and move in careful steps toward goals. "We must know in what direction we are moving", he said, "and at the same time make sure where we are going to put our foot for the next step". "Looking forward to the distant future", he wrote, "does not mean dreaming and waiting - it means doing at once whatever is in our power to prepare for it".(1)

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(1) For these and other statements by Berger, and a discussion of them, see a paper by Henri Dieuzeide, The Possible Uses of Communication Satellites in Education, written for the Unesco Meeting of Experts on the Use of Space Communication by the Mass Media, 6-10 December 1965, and duplicated by Unesco, Paris, 1965, pp. 2-3.

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